



Department
for Education

A guide to value added key stage 1 to 2 in 2015 school performance tables

February 2016

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Summary – Interpreting school value added scores

Example of school VA information from performance tables

Institution Name	Measure centred around 100 VA measure based on progress between Key Stage 1 and Key Stage 2	Limit of Key Stage 1 to 2 VA Confidence Intervals	
		Upper	Lower
School A	101.9	102.8	101.1
School B	99.8	100.8	98.9
School C	98.5	99.5	97.6

The higher the school's VA score, the more progress the pupils in the school are making, with 100 representing the national average progress.

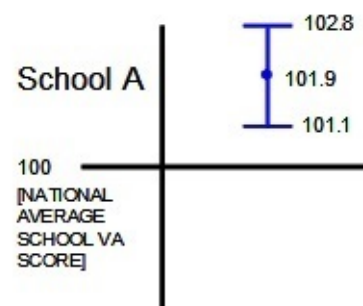
The higher the school's VA score, the more progress the pupils in the school are making, with 100 representing the national average progress.

KEY:

Upper Confidence Limit
School VA Score
Lower Confidence Limit

Displaying a school's VA information visually on a chart

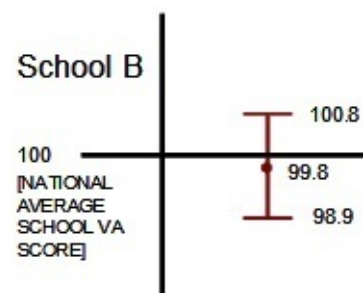
How to interpret the information and chart



School A's VA score is above the national average and this is statistically significant

This is because the whole range of the confidence interval is above 100

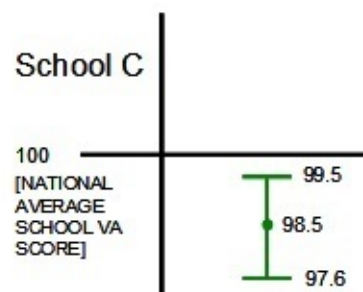
This tells us that the pupils in this school make **more progress than average**



School B's VA score is not significantly different from the national average

This is because the range of the confidence interval straddles the national average of 100

This tells us that the pupils in this school make **progress comparable with the average**



School C's VA score is below the national average and this is statistically significant

This is because the whole range of the confidence interval is below 100

This tells us that the pupils in this school make **less progress than average**

What is value added?

When measuring how effective a school is, it is important to look at how well its pupils perform in their tests and examinations. However, when evaluating test performance it is also important to take into consideration that pupils moving from key stage 1 (KS1) to key stage 2 (KS2) have varying levels of ability, i.e. pupils at the beginning of KS2 have many different starting points.

So a measure is needed that looks at how much progress pupils have made between the end of KS1 and the end of KS2. This is the purpose of value added (VA).

Analysis shows that there is a very strong relationship between performance of pupils at a previous key stage and their current key stage. A VA measure uses this relationship to “estimate” how well all pupils perform in their current key stage assessments. In 2015, there are four key stage 1 to key stage 2 (KS1-2) VA measures, each estimating a KS2 outcome for all pupils nationally that are at the end of KS2.

For the KS1-2 VA measures, an individual pupil’s “*estimated outcome*” at the end of KS2 is calculated by looking at the *actual* KS2 performance of all pupils nationally that demonstrated similar ability in their assessments at the end of KS1.

More specifically, we estimate a pupil’s KS2 outcome as the average KS2 points achieved by pupils nationally of similar ability at KS1. This KS2 estimated outcome can then be compared against what the pupil actually achieved in their KS2 tests, to see whether or not they exceeded it. The difference between a pupil’s actual KS2 performance and their estimated KS2 performance gives the pupil their VA score.

The average VA score for all pupils in a school can then be calculated to find a school’s VA score, which helps to identify schools that are helping their pupils make more progress or less progress than average. The summary diagrams on pages 2 and 14 show how to interpret these scores for schools and pupil groups.

The performance tables website shows school VA scores for the following four KS1-2 VA measures:

- KS1-2 overall VA measure – progress in reading, writing and mathematics combined.
- KS1-2 reading VA measure – progress in reading only.
- KS1-2 writing VA measure – progress in writing only.
- KS1-2 mathematics VA measure – progress in mathematics only.

Please see page 13 for further information on the four VA measures above.

Calculating pupil value added scores

Individual pupil VA scores need to be calculated before a school VA score can be produced.

The first step is to use a statistical model to calculate an “estimated outcome” for all pupils that are at the end of KS2 in 2015. Each pupil’s KS2 estimate is calculated based on the actual KS2 outcomes of all pupils nationally with the same level of achievement at KS1. For example, calculation of an estimated outcome for a pupil who scored an average of 15 points at KS1 will be based on the actual KS2 outcomes of all pupils nationally that also scored an average of 15 points at KS1.

A pupil’s VA score is then calculated by subtracting their estimated KS2 outcome from their actual KS2 outcome. Using the KS1-2 mathematics VA measure as an example, if a pupil attains a level 4 in KS2 mathematics (equivalent to 27 points) and they are estimated to attain a Level 3 (equivalent to 21 points) by the VA measure, then the pupil has a VA score of +6 points (27 points – 21 points).

The positive score tells us that this pupil has exceeded their estimated KS2 outcome. If the VA score was negative, then this would tell us that the pupil scored less than their estimated KS2 outcome. The table below summarises the calculation described above.

Pupil's actual KS1 average point score	<i>Performance of all pupils with an average score of 15 at KS1 used to estimate performance at KS2</i>	Pupil's estimated KS2 maths score	Pupil's actual KS2 maths score	Difference (actual - estimate)
15 points	→	Level 3 (21 points)	Level 4 (27 points)	+6 points (27-21)

Section B of the technical annex provides a more detailed description of how pupils’ estimated KS2 scores and their VA scores are calculated.

If you wish to use some data to better understand the pupil VA calculation, a useful resource is the KS1-2 Pupil Level VA Ready Reckoner which RAISEonline¹ users can find in the library on [RAISEonline](#) and it is also on the [performance tables](#) website.

¹ RAISEonline is an analytical tool used by schools to analyse school and pupil performance data.

Calculating school value added scores

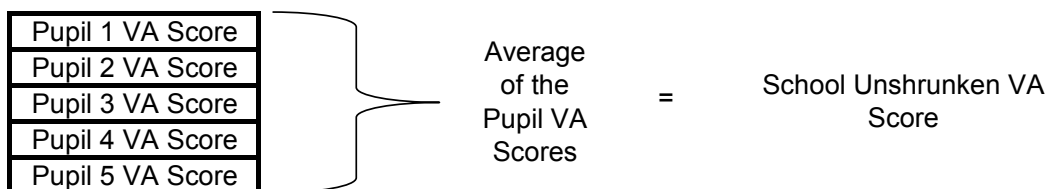
Once the pupil VA scores have been calculated, we take the average of all the pupil VA scores within that school.

We then apply the *shrinkage factor*, an adjustment that provides a better estimate of VA scores for schools with small numbers of pupils.

Finally, to differentiate between the KS1-2 and KS2-4 VA measures, we *centre* by adding 100 to every KS1-2 school VA score (KS2-4 VA scores are centred on 1,000).

The diagram below shows an example of how a school VA score is calculated from an example of five pupil VA scores.

STEP 1 - FIND THE AVERAGE OF PUPIL SCORES



STEP 2 - APPLY THE SHRINKAGE FACTOR

$$\text{School Unshrunk VA Score} \times \text{Shrinkage Factor} = \text{School Shrunk VA Score}$$

STEP 3 - CENTRE THE SCHOOL VA SCORE

$$\text{School Shrunk VA Score} + 100 = \text{Centred Final School VA Score}$$

For more information on calculating school VA scores, including the application of shrinkage factors, please see section C of the technical annex.

Interpreting school value added scores

We can use the school VA score as a measure of school effectiveness, but we must be careful to note that it is based on a given set of pupils' results for a particular test paper on a particular day.

A school could have been equally effective and yet the same set of pupils might have achieved slightly different KS2 results on the day. And the school would almost certainly have shown slightly different KS2 results with a different set of pupils. This element of uncertainty needs to be taken into account when interpreting a school's VA score; this is done using *confidence intervals*.

A confidence interval is a range of scores within which we are statistically confident that a school's true VA score will fall. A school's confidence interval is always centred on the school's VA score. For example, if a school's VA score is 101 and the size of the school's confidence interval is 2 points, then the confidence interval ranges between 99 and 103 (i.e. 2 points either side of the school's VA score).

The size of the confidence interval is determined by the number of pupils in the school at the end of KS2. Smaller schools have wider confidence intervals because their VA score is based on a smaller number of pupils, so there is less evidence on which to judge the school's effectiveness.

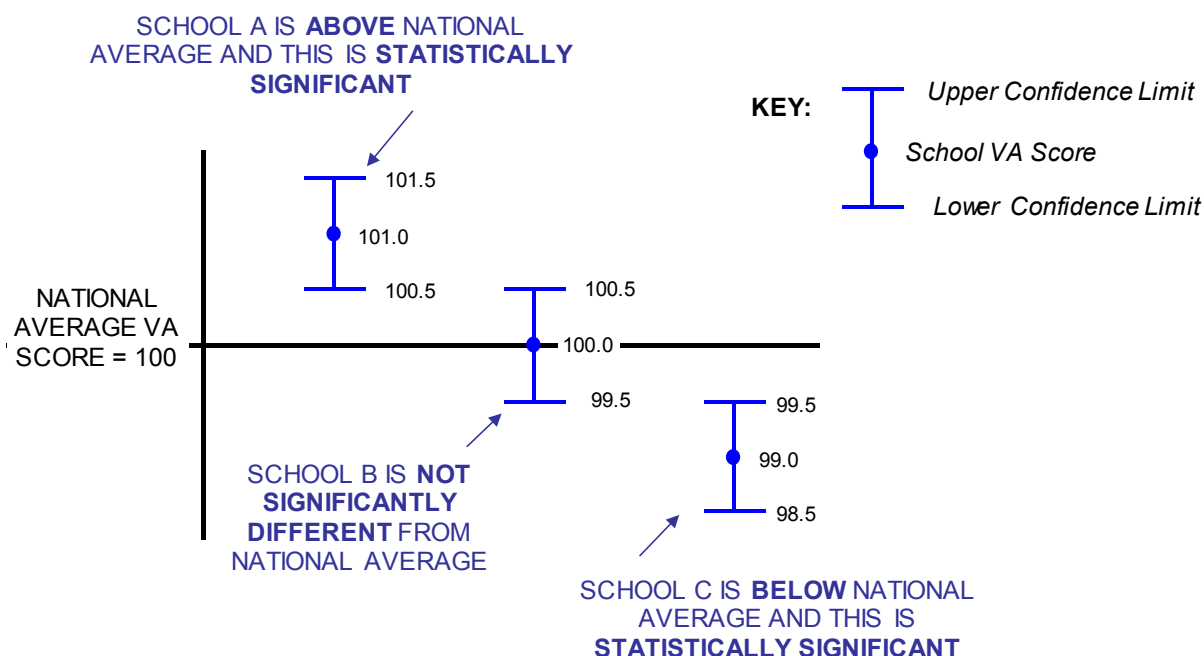
To judge a school's effectiveness, both the school's VA score and the associated confidence interval needs to be taken into account. If the whole range of the confidence interval is above 100 (i.e. the lower confidence limit is greater than 100), we can say the school score is *above* the national average and is *statistically significant*, and we can be confident the school is helping its pupils make better than average progress. An illustration of how to interpret school VA scores is given on page 2.

Similarly, when the entire range of the confidence interval is below 100 (i.e. the upper confidence limit is less than 100), we can say the school score is *below* the national average and is *statistically significant*.

Finally, if the confidence interval straddles the national average of 100, then we can say that the school is *not significantly different* from the national average. In other words, we cannot say with confidence that the school's VA score is definitely above or definitely below the national average.

The table and diagram overleaf shows how a school's VA score and confidence intervals should be interpreted to reach one of the three definitions above. School A is an example of a school that is significantly above national average; School B is not significantly different from national average; and School C is significantly below national average;

	School A	School B	School C
School VA Score	101.0	100.0	99.0
Upper Confidence Interval	101.5	100.5	99.5
Lower Confidence Interval	100.5	99.5	98.5



For more information on the calculation of confidence intervals, please see Section E of the technical annex. Another useful resource is the KS1-2 School Level Ready Reckoner, which demonstrates how the number of eligible pupils for a VA score in a school is linked to the width of a school's confidence interval. RAISEonline users can find this in the Library on [RAISEonline](#) and it is also on the [performance tables](#) website.

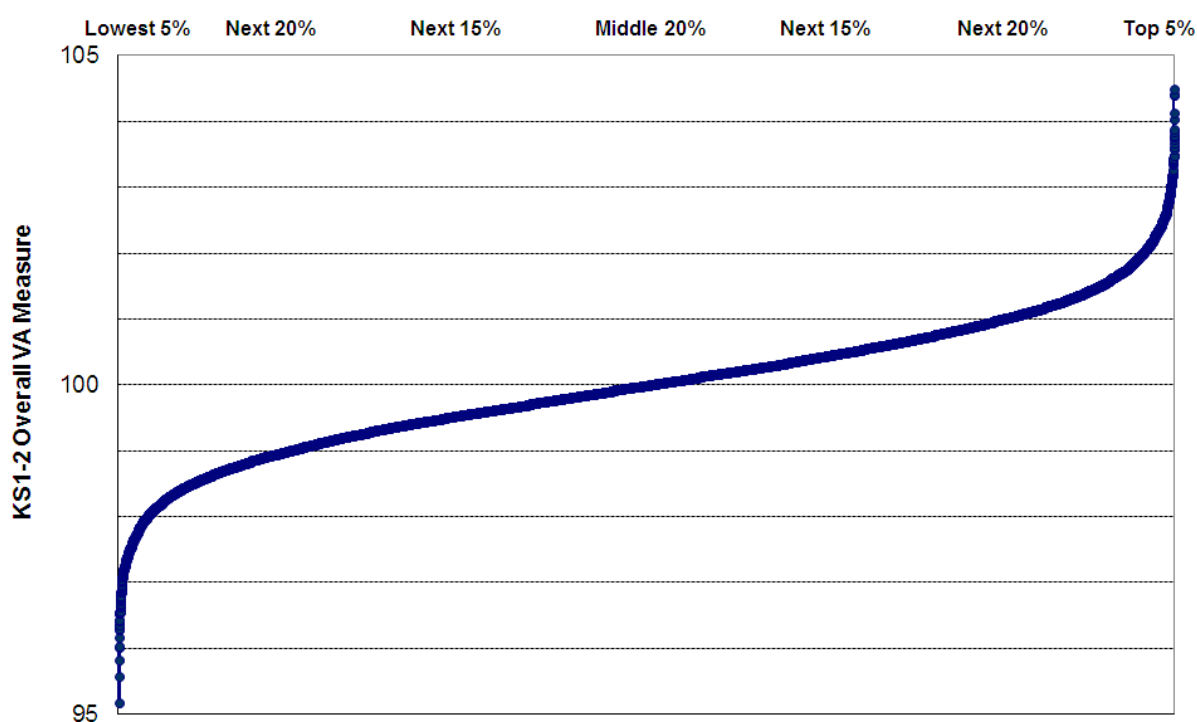
KS1-2 overall value added percentiles

The KS1-2 overall VA scores for mainstream schools have been separated into percentiles, shown in the table below. The percentiles illustrate the distribution of KS1-2 overall VA scores, and show where schools are placed nationally compared to other schools based on their score. They are derived from national results for mainstream schools only.

KS1-2 overall VA measure (centred on 100)	
All state-funded mainstream Schools	Percentiles
101.7 and above	Top 5% of schools nationally
100.7 to 101.6	Next 20% of schools nationally
100.3 to 100.6	Next 15% of schools nationally
99.8 to 100.2	Middle 20% of schools nationally
99.4 to 99.7	Next 15% of schools nationally
98.4 to 99.3	Next 20% of schools nationally
98.3 and below	Bottom 5% of schools nationally

The percentiles for 2015 shown above are provided for information only, and the band into which an individual school falls will not be published in school performance tables. It is important to note that the percentiles are applicable to 2015 amended data only.

Snake plots are a useful way of presenting percentiles. The snake plot below simply repeats the information shown in the table above but in a way that enables the national distribution to be more easily understood.



Calculating pupil group value added scores

The school and college performance tables include information to highlight how pupils of different starting abilities perform within each school. Pupils are grouped based on their performance at the end of an earlier key stage. For the primary school performance tables, pupils are grouped based on their performance at KS1. The VA score will be shown for pupils previously performing:

- Below the expected level (level 2) at KS1;
- At the expected level (level 2) at KS1;
- Above the expected level (level 2) at KS1.

The average pupil VA scores for the three pupil groups described above will be presented for the KS1-2 overall VA measure. This information is available for individual schools.

Similarly, the average pupil VA scores for 'disadvantaged' pupils – defined, for performance tables purposes, as those who were either eligible for free school meals (FSM) at any time in the previous 6 years or are looked-after children (CLA) – will be presented for the KS1-2 overall VA measure in the performance tables supporting dataset, again available for individual schools.

The average VA score for a particular pupil group in a school is calculated as the average of the VA scores for each individual pupil that belongs to that pupil group in the school.

A shrinkage factor is **not** applied to pupil groups within schools. A shrinkage factor is only applicable when calculating school VA scores and is not appropriate for applying to subsets of pupils within schools or to national level figures. As a result, for schools with all pupils belonging to one pupil group (for example, all pupils were at the expected level at KS1), the pupil group VA score will differ slightly to the school VA score. In these cases the unshrunk (pupil group) VA score should be used when comparing VA scores for that pupil group and the shrunk (school) VA scores should be used when comparing the school to all pupils nationally.

Interpreting pupil group value added scores

We can also use the school pupil group VA score as a measure of school effectiveness for a particular pupil group using a similar method as school VA score. Similarly, it is important to note that this score is based on a given set of pupils' results (who belong to a pupil group) for a particular test paper on a particular day.

To compare pupil group VA scores, confidence intervals are also calculated to give a range of scores within which we are statistically confident that a school's pupil group VA score will fall. There are two ways in which a pupil group VA score can be compared; to the national average for **all pupils** (100) or to the **national pupil group average**.

For an explanation of how to interpret confidence intervals, please refer back to page 6 (Interpreting school value added scores) and an illustration of how to interpret pupil group VA scores is also given on section A of the technical annex.

The 2015 amended KS1-2 value added measures

There are four KS1-2 VA measures published in the 2015 performance tables:

- KS1-2 overall VA measure which looks at progress in reading, writing and mathematics combined
- KS1-2 reading
- KS1-2 writing
- KS1-2 mathematics

KS1-2 overall VA measure

The KS1-2 overall VA measure is used to see how effective schools are in helping their pupils' progress from KS1 to KS2 in reading, writing and mathematics.

The measure estimates for each pupil their average point score in KS2 reading, writing and mathematics. A pupil's VA score is then calculated by finding the difference between the average point score the pupil actually achieved in KS2 reading, writing and mathematics and the average point score they were estimated to achieve.

RAISEonline users can find more information on converting grades to point scores in the library on [RAISEonline](#), and these can also be found on the [performance tables](#) website.

KS1-2 reading VA measure

The KS1-2 reading VA measure is used to see how effective schools have been in helping their pupils' progress from KS1 to KS2 reading.

The measure estimates for each pupil their point score in KS2 reading. A pupil's VA score is then calculated by finding the difference between the point score the pupil actually achieved in KS2 reading and the point score they were estimated to achieve.

KS1-2 writing VA measure

The KS1-2 writing VA measure is used to see how effective schools have been in helping their pupils' progress from KS1 to KS2 writing

The measure estimates for each pupil their point score in KS2 writing. A pupil's VA score is then calculated by finding the difference between the point score the pupil actually achieved in KS2 writing and the point score they were estimated to achieve.

KS1-2 mathematics VA measure

The KS1-2 mathematics VA measure is used to see how effective schools have been in helping their pupils' progress from KS1 to KS2 mathematics.

The measure estimates for each pupil their point score in KS2 mathematics. A pupil's VA score is then calculated by finding the difference between the point score the pupil actually achieved in KS2 mathematics and the point score they were estimated to achieve by the VA measure.

Changes to KS1-2 VA measures in 2015

In 2015 no changes to the KS1-2 VA measure were made to the way in which pupils VA and school VA are calculated.

Since 2013, the department has no longer produced English progress measures at key stage 2 - this includes the KS1-2 English VA measure. This has been replaced by separate VA measures in reading and writing. For 2015 this will remain the same.

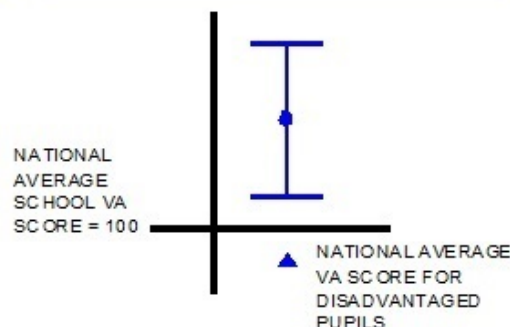
The reading VA measure is calculated in the same manner as the mathematics measure - each pupil's test marks are converted to fine grades and where necessary a teacher assessment (TA) adjustment is applied (see section G and H of the technical annex). The writing VA measure uses a pupil's teacher assessment level. Teacher assessment levels W through to 6 are converted to a fine grade then a point score (see section H of the technical annex). Details of how the overall VA measure is calculated are shown in section H of the technical annex.

Section A – Interpreting school VA scores for pupil groups – disadvantaged pupils

Example of a school's VA Information from performance tables for disadvantaged pupils

	Disadvantaged Pupils
Overall VA measure - disadvantaged pupils	104.0
Overall VA lower 95% confidence limit for disadvantaged pupils	102.2
Overall VA upper 95% confidence limit for disadvantaged pupils	105.8

Displaying a school's VA Information for disadvantaged pupils visually on a chart



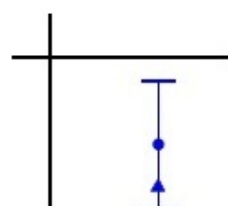
How to interpret the information and chart

The VA score for disadvantaged pupils is **above the national average for all pupils** and the national average for disadvantaged pupils and both results are statistically significant.

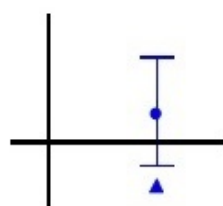
This is because the whole range of the confidence interval is above 100 and the national average for disadvantaged pupils.

This tells us that disadvantaged pupils in this school make **more progress than average for all pupils and disadvantaged pupils nationally**

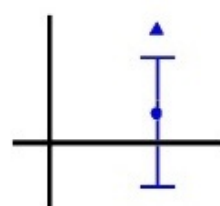
Other examples of possible outcomes



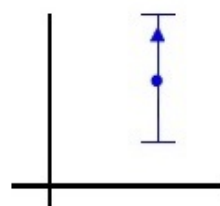
ALL PUPILS DISADVANTAGED **BELOW NO SIG**



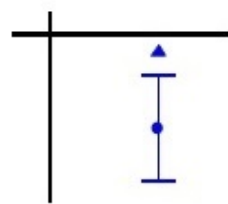
ALL PUPILS DISADVANTAGED **NO SIG ABOVE**



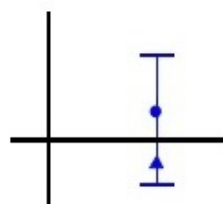
ALL PUPILS DISADVANTAGED **NO SIG BELOW**



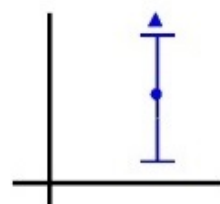
ALL PUPILS DISADVANTAGED **ABOVE NO SIG**



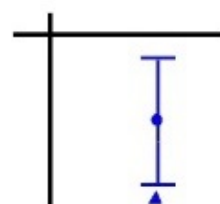
ALL PUPILS DISADVANTAGED **BELOW BELOW**



ALL PUPILS DISADVANTAGED **NO SIG NO SIG**



ALL PUPILS DISADVANTAGED **ABOVE BELOW**



ALL PUPILS DISADVANTAGED **BELOW ABOVE**

KEY:



Upper Confidence Limit

School VA Score

Lower Confidence Limit

National Average VA Score for Disadvantaged Pupils

NO SIG Not Significantly Different
ABOVE Above average and this is statistically significant
BELOW Below average and this is statistically significant

Note: VA scores are also available for non-disadvantaged pupils and low, middle and high attainers

Section B – Calculating pupil value added scores

Behind each KS1-2 VA measure sits a separate statistical model. The four models generate an estimate of attainment for each pupil, respectively in KS2 reading, writing, mathematics and an overall estimate for KS2 reading, writing and mathematics combined.

The estimated KS2 attainment outcomes are expressed as a point score, and are based on the performance nationally of all pupils with the same KS1 prior attainment. The VA score for a pupil is then calculated as the difference (positive or negative) between the model's estimate for pupils like them nationally and their actual KS2 attainment.

Pupil eligibility for inclusion in VA models

The same cohort of pupils is included in all four KS1-2 VA models, namely if:

- their key stage 2 attainment in reading, writing and mathematics can be matched to their attainment at key stage 1;
- they have a KS1 average point score that is greater than zero;
- they do not have a disregarded outcome in either KS2 reading, writing or mathematics;
- they attend a state-funded mainstream school (including academies, free schools and city technology colleges) – see section F for calculation of special school VA scores.

All state-funded mainstream and special schools will have a VA score for all four KS1-2 VA measures, provided they have at least one eligible pupil for each measure.

Methodology for pupil VA calculation

The models produce coefficients to be applied to the pupil level KS1 prior attainment variables described below. We use the same prior attainment variables for all four KS1-2 VA measures.

For each KS1-2 VA measure, the estimated KS2 attainment of the pupil E_p is given by:

$$E_p = c + (c_1 \times KS1APS) + (c_2 \times KS1APS^2) + (c_3 \times KS1APS^3) \\ + (c_4 \times READEV) + (c_5 \times MATDEV)$$

where:

$KS1APS$	is the pupil's KS1 average point score (APS)
$KS1APS^2$	is the pupil's KS1 APS squared
$KS1APS^3$	is the pupil's KS1 APS cubed
$READDEV$	is the difference between the pupil's KS1 Reading score and their KS1 APS
$MATDEV$	is the difference between the pupil's KS1 mathematics score and their KS1 APS
c_i	are the coefficients from the VA model
c	is the constant from the VA model

Note that the values c_i and c will be different for each of the four KS1-2 VA measures.

The VA score of the pupil, VA_p , is then calculated as the difference between their actual result and their estimate (E_p), given by:

$$VA_p = A_p - E_p,$$

where:

A_p	is the pupil's actual point score
-------	-----------------------------------

Note that VA_p scores are centred on 0.

Worked example (referring to KS1-2 overall VA measure)

A pupil at the end of key stage 2 has the following attainment:

Surname	Bibby
Forename	Bobbie
KS1 reading	2B
KS1 writing	2C
KS1 mathematics	3
KS2 reading	25.68
KS2 writing	21.00
KS2 mathematics	31.50

We convert levels to point scores as follows:

KS1 reading = Level 2B = 15 points

KS1 writing = Level 2C = 13 points

KS1 mathematics = Level 3 = 21 points

$$KS1 APS = \frac{15+13+21}{3} = 16.33 \text{ points}$$

$$KS2 APS = \frac{(25.68 + 21.00) / 2 + 31.50}{2} = 27.42 \text{ points}$$

Bobbie's estimated KS2 attainment is calculated by inserting the following values, reflecting her KS1 outcomes, into the formulae given above for E_p :

Notation	Description	Pupil value
<i>KS1APS</i>	KS1 APS	16.33
<i>KS1APS</i> ²	KS1 APS squared	266.67
<i>KS1APS</i> ³	KS1 APS cubed	4,354.70
<i>READDEV</i>	KS1 reading minus KS1 APS	-1.33
<i>MATDEV</i>	KS1 mathematics minus KS1 APS	4.67

The table below presents the 2015 amended overall KS1-2 model coefficients:

Coefficient	Applied to	Coefficient
<i>c</i>	Constant applied to all pupils	13.8124
<i>c</i> ₁	<i>KS1APS</i>	0.9682
<i>c</i> ₂	<i>KS1APS</i> ²	0.000751
<i>c</i> ₃	<i>KS1APS</i> ³	-0.000019
<i>c</i> ₄	<i>READDEV</i>	-0.0214
<i>c</i> ₅	<i>MATDEV</i>	0.3565

Bobbie's estimated KS2 attainment, E_p , is then calculated as:

$$\begin{aligned}
 E_p &= c + (c_1 \times KS1APS) + (c_2 \times KS1APS^2) + (c_3 \times KS1APS^3) \\
 &\quad + (c_4 \times READDEV) + (c_5 \times MATDEV) \\
 &= 13.8124 + (0.9682 \times 16.33) + (0.000751 \times 266.67) + (-0.000019 \times 4354.70) \\
 &\quad + (-0.0214 \times -1.33) + (0.3565 \times 4.67) \\
 &= 13.8431 + 15.810706 + 0.200269 - 0.082739 + 0.028462 + 1.664855 \\
 &= 31.43 \text{ (2 decimal place, or d.p.)}
 \end{aligned}$$

Bobbie's actual KS2 APS $A_p = 27.42$. Therefore, her VA score is given by:

$$VA_p = A_p - E_p = 27.42 - 31.43 = -4.01 \text{ (2 d.p.)}$$

Section C – Calculating school value added scores

The VA score for a school is then calculated as the average VA score of all pupils in the school, with an adjustment made by way of the application of a “shrinkage factor” for each school. The shrinkage factor is used to improve the accuracy of estimates of schools’ VA scores by drawing them towards the national average of 100. Each school has its own shrinkage factor, the size of which depends on the variance within and between schools nationally, as well as the size of the actual school’s cohort. The effect of the shrinkage factor is greater for smaller schools.

Methodology for school VA calculation

The school KS1-2 VA score, VA_s , is given by:

$$VA_s = 100 + (S \times \overline{VA_p}) ,$$

where:

S	is the “shrinkage factor” for the school
$\overline{VA_p}$	is the average VA score for all eligible pupils within the school, given by:

$$\overline{VA_p} = \frac{\sum_{p=1}^{n_s} VA_p}{n_s} ,$$

where:

N_s	is the number of eligible pupils in the school
$\sum_{p=1}^{n_s} VA_p$	is the sum of the VA scores of eligible pupils within the school

The “shrinkage factor”, S , is given by:

$$S = \frac{B}{B + \frac{W}{n_s}}$$

where:

B	is the national variance between schools
W	is the national variance within schools

Note each of the four KS1-2 VA measures will have a separate value for both B and W .

Worked example (continuation)

Let us then say that Bobbie is one of 100 pupils in her school's KS2 cohort, who gain a range of KS1-2 VA scores:

Pupil #	Pupil name	VA score
1	Bobbie	-4.01
2	Carl	1.59
⋮	⋮	⋮
100	Karolina	0.60
Sum		28.26

The next step in the calculation is to calculate \overline{VA}_p , the average VA score for all eligible pupils within the school KS2 cohort:

$$\overline{VA}_p = \frac{\sum_{p=1}^{n_s} VA_p}{n_s} = \frac{(-4.01 + 1.59 + \dots + 0.06)}{100} = \frac{28.26}{100} = 0.283 \quad (3 \text{ d.p.})$$

We next calculate the “shrinkage factor”, using 2015 overall KS1-2 model values for B (1.252871) and W (5.531229):

$$S = \frac{B}{B + \frac{W}{n_s}} = \frac{1.252871}{\left(1.252871 + \frac{5.531229}{100}\right)} = 0.958 \quad (3 \text{ d.p.})$$

Hence the final KS1-2 Overall VA score for this school, VA_s , is given by:

$$VA_s = 100 + (S \times \overline{VA}_p) = 100 + (0.957718 \times 0.283) = 100.271 \quad (3 \text{ d.p.})$$

Note: We would publish this score as 100.3, but retain the decimal places for this example for illustrative purposes later in confidence interval calculations.

Section D – Calculating pupil group value added scores

The VA score for any particular pupil group (e.g. ‘disadvantaged’ pupils, pupils previously performing above level 2 at KS1 etc.) in a school is calculated as the average VA score of all pupils that belong to the pupil group in the school. Similarly, the VA score for a particular pupil group nationally is calculated as the average VA score of all pupils that belongs to the pupil group nationally.

Methodology for pupil group VA calculation

The pupil group KS1-2 VA score for any school, VA_g , is given by:

$$VA_g = 100 + \overline{VA}_{pg} ,$$

where:

\overline{VA}_{pg}	is the average VA score for all eligible pupils that belong to the pupil group within the school, given by:
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$$\overline{VA}_{pg} = \frac{\sum_{p=1}^{n_{pg}} VA_p}{n_{pg}} ,$$

where:

n_{pg}	is the number of eligible pupils that belong to the pupil group within the school
$\sum_{p=1}^{n_{pg}} VA_p$	is the sum of the VA scores of eligible pupils that belong to the pupil group within the school

Note a “shrinkage factor” is not applied to pupil groups within schools.

Methodology for national pupil group VA calculation

The national KS1-2 VA score for a pupil group, VA_G , is given by:

$$VA_G = 100 + \overline{VA}_{PG} ,$$

where:

\overline{VA}_{PG}	is the average VA score for all eligible pupils that belong to the pupil group nationally, given by:
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$$\overline{VA}_{PG} = \frac{\sum_{p=1}^{n_{PG}} VA_p}{n_{PG}},$$

where:

n_{PG}	is the number of eligible pupils that belong to the pupil group nationally
$\sum_{p=1}^{n_{PG}} VA_p$	is the sum of the VA scores of eligible pupils that belong to the pupil group nationally

Note a “shrinkage factor” is not applied to pupil groups nationally.

Worked example 1 (KS1-2 overall VA measure – continuation)

Let us then say that Bobbie is one of 30 ‘disadvantaged’ pupils among the 100 pupils in her school’s KS2 cohort, who gain a range of *KS1-2 overall* VA scores:

Disadvantaged pupil #	Disadvantaged pupil name	VA score
1	Bobbie	-4.01
2	Rosie	4.19
⋮	⋮	⋮
30	Adam	1.75
Sum		22.65

We calculate the disadvantaged pupil group VA score for the school, VA_g , by calculating the average VA score of the disadvantaged pupils within the school, as follows:

$$\begin{aligned}
 VA_g &= 100 + \overline{VA}_{pg} = 100 + \frac{\sum_{p=1}^{n_{pg}} VA_p}{n_{pg}} \\
 &= 100 + \frac{(-4.01 + 4.19 + \dots + 1.75)}{30} = 100 + \frac{22.65}{30} = 100.755 \text{ (3 d.p.)}
 \end{aligned}$$

Note: We would publish this score as 100.8, but retain the decimal places for this example for illustrative purposes for the confidence interval calculation.

Section E – Calculating confidence intervals

A 95% confidence interval is calculated around the school VA score, defining the range of values within which we are statistically confident that the true value of the school's VA score lies.

Methodology for school VA confidence interval calculation

The confidence interval, denoted $[LowCI_s, UppCI_s]$, is given by the formula:

$$[LowCI_s, UppCI_s] = [VA_s - CI_s, VA_s + CI_s],$$

where:

$LowCI_s$	is the lower confidence limit for the school's VA score
$UppCI_s$	is the upper confidence limit for the school's VA score
VA_s	is the school's VA score
CI_s	is the size of the confidence interval for the school, given by:

$$CI_s = 1.96 \times \sqrt{\frac{B \times W}{(B \times n_s) + W}}$$

For each KS1-2 VA measure, the national average of all state-funded mainstream school scores is 100.

- When a school has $LowCI_s > 100$, the school's VA score is above average and the result is statistically significant (denoted "Sig+").
- When a school has $UppCI_s < 100$, the school's VA score is below average and the result is statistically significant (denoted "Sig-").
- In the other case when $LowCI_s < 100 < UppCI_s$, we cannot say with confidence whether the school's VA score is above or below average, and say the result is not statistically significant.

See **section F** for calculation of special school confidence intervals.

Worked example (continuation)

Using the 2015 KS1-2 overall VA model values for B (1.252871) and W (5.531229), We calculate the size of the confidence interval for the school's VA score, CI_s , as follows:

$$CI_s = 1.96 \times \sqrt{\frac{B \times W}{(B \times n_s) + W}}$$

$$= 1.96 \times \sqrt{\frac{1.252871 \times 5.531229}{(1.252871 \times 100) + 5.531229}} = 1.96 \times 0.230160 = 0.451 \quad (3 \text{ d.p.})$$

We derive the confidence interval for the school's VA score:

$$\begin{aligned} [LowCI_s, UppCI_s] &= [VA_s - CI_s, VA_s + CI_s] \\ &= [100.271 - 0.451, 100.271 + 0.451] = [99.8, 100.7] \quad (1 \text{ d.p.}) \end{aligned}$$

Hence, as $LowCI_s < 100 < UppCI_s$, we cannot say with confidence whether this school's VA score is above or below average, hence the school's VA score is not statistically significant either side of the national average.

Methodology for pupil group VA confidence interval calculation

A 95% confidence interval is calculated around each pupil group VA score for the school, defining the range of values within which we are statistically confident that the true value of the pupil group VA score for the school lies.

The confidence interval, denoted $[LowCI_g, UppCI_g]$, is given by the formula:

$$[LowCI_g, UppCI_g] = [VA_g - CI_g, VA_g + CI_g],$$

where:

$LowCI_g$	is the lower confidence limit for the pupil group VA score for the school
$UppCI_g$	is the upper confidence limit for the pupil group VA score for the school
VA_g	is the pupil group VA score for the school
CI_g	is the size of the confidence interval for the pupil group VA score for the school, given by:

$$CI_g = 1.96 \times \frac{\sigma_N}{\sqrt{n_{pg}}}$$

where:

VA_g	is the school's VA estimate for that pupil group
σ_N	is the standard deviation of the VA scores for all eligible pupils <u>nationally</u> ;
N_{pg}	is the number of eligible pupils that belong to the pupil group within the school;

We are interested in how the pupil group within the school performs compared to all pupils nationally; hence we test for significance by comparing the range of the confidence interval to the national mainstream school pupil KS1-2 VA average, i.e. 100.

- When a pupil group within a school has $LowCI_g > 100$, the school's pupil group VA score is above the national pupil VA score and the result is statistically significant (denoted "Sig+").
- When a pupil group within a school has $UppCI_g < 100$, the school's pupil group VA score is below the national pupil VA score and the result is statistically significant (denoted "Sig-").
- In the other case when $LowCI_g < 100 < UppCI_g$, we cannot say with confidence whether the school's pupil group VA score is above or below the national pupil VA score, and say the result is not statistically significant.

See **section F** for calculation of special school pupil group confidence intervals and significance testing.

Worked example (continuation)

Referring back to the disadvantaged pupil group example on page 21, we can then calculate the size of the confidence interval for the school's disadvantaged pupil group VA score using CI_g :

$$CI_g = 1.96 \times \frac{\sigma_N}{\sqrt{n_{pg}}} = 1.96 \times \frac{2.603590}{\sqrt{30}} = 1.96 \times 0.475348 = 0.932 \text{ (3 d.p.)}$$

We derive the confidence interval for the school's disadvantaged pupil group VA score:

$$\begin{aligned} [LowCI_g, UppCI_g] &= [VA_g - CI_g, VA_g + CI_g] \\ &= [100.755 - 0.932, 100.755 + 0.932] = [99.8, 101.7] \text{ (1 d.p.)} \end{aligned}$$

As $LowCI_g < 100 < UppCI_g$, we cannot say with confidence whether the school's disadvantaged pupil group VA score is above or below the national pupil VA score, and say this result is not statistically significant.

We can also test for significance by comparing the range of the confidence interval to VA_G the national VA score for the pupil group in mainstream schools.

- When a pupil group within a school has $LowCI_g > VA_G$, the school's pupil group VA score is above the national pupil group VA score and the result is statistically significant (denoted "Sig+").
- When a pupil group within a school has $UppCI_g < VA_G$, the school's pupil group VA score is below the national pupil group VA score and the result is statistically significant (denoted "Sig-").

- In the other case when $LowCI_g < VA_G < UppCI_g$, we cannot say with confidence whether the school's pupil group VA score is above or below the national pupil group VA score, and say the result is not statistically significant.
- When a pupil group within a school has $LowCI_g > 100$, the school's pupil group VA score is above the national VA score for all pupils, and the result is statistically significant (denoted "Sig+").
- When a pupil group within a school has $UppCI_g < 100$ the school's pupil group VA score is below the national VA score for all pupils and the result is statistically significant (denoted "Sig-").
- In the other case when $LowCI_g < 100 < UppCI_g$, we cannot say with confidence whether the school's pupil group VA score is above or below the national VA score for all pupils, and say the result is not statistically significant.

When comparing a school's pupil group VA score to the national pupil group average and the national average for all pupils, It could be the case that the VA score is statistically significant in one result but not in the other, or indeed "Sig +" in one and "Sig –" in the other. For example, a school's VA score for their disadvantaged pupils could be "Sig +" compared with the national VA score for disadvantaged pupils but still "Sig-" compared with the national VA score for all pupils. In other words, the school's disadvantaged pupils are making progress above the national average for disadvantaged pupils and this is statistically significant, but are still performing below average of all pupils nationally and this is also statistically significant. Please see page 12 for a further explanation of the interpretation of pupil group VA scores.

Section F – Special school value added scores

The estimated KS2 attainment (E_p) for pupils in special schools is based on comparison with pupils of the same prior attainment in mainstream schools. This means that their VA scores are calculated based on the model coefficients (c_i and c) derived from mainstream schools only.

Similarly, confidence intervals for special schools and their pupils groups are calculated using the values from the mainstream school model. Comparisons are then made to mainstream school national averages (100 for the school VA scores).

Section G – KS2 teacher assessment adjustment

The following table summarises how TA adjustments are applied to pupils without a test score in reading or mathematics or have a test score at level 2 or below. The intention of the adjustment is to better reflect the attainment of low attaining pupils by substituting their reading and mathematics TA data if their corresponding test result is any of the levels shown in the first column of table 1. For example, if a pupil obtains a level 2 in their reading test and their TA is a level 2, then the pupil would be awarded 15 points.

If a pupil is awarded level 2, B or N in one of their test levels or is listed as A, M, Q, S, T, X and no TA exists the pupil is excluded from VA measures as we have no means of validating the pupil's actual ability.

Table 1 Teacher assessment adjustment

If test level =		
6	Pupil's fine grade score = 39	
3-5	Use pupil's fine grade score	
2	If TA available	Award: W = 3 Level 1 = 9 Level 2 = 15 Any higher = use pupil's fine grade score A,D,F,L,P,Z = Exclude pupil
	If no TA available	Exclude Pupil
B, N	If TA available	Award: W = 3 Level 1 = 9 Level 2 = 15 Any higher = 15 (capped) A,D,F,L,P,Z = Exclude pupil
	If no TA available	Exclude Pupil
A, M, Q, S, T, X	If TA available	Award: W = 3 Level 1 = 9 Level 2 = 15 Level 3 = 21 Level 4 = 27 Level 5 = 33 Any higher = 33 (capped) A,D,F,L,P,Z = Exclude pupil
	If no TA available	Exclude Pupil

Notes on grade codes

- A** – Absent
- B** – Working below the level of the test
- D** – Disapplied
- F** – KS2 pupil not at end of KS2 and taking this subject in future years
- L** – Left
- N** – Not awarded a test level
- M** – Missing
- P** – Results for subject found in previous year's dataset
- S** – Pending maladministration
- Q** – Maladministration
- T** – Working at the level of the tests but not able to access them
- X** – Lost
- Z** – Ineligible

Section H – Calculating KS2 fine grades

Key stage 2 point scores are based on the levels that pupils achieved in their end of key stage assessment. Fine grades use the underlying marks data to create a finer measure.

Reading and mathematics

The following set of rules is used to convert test marks to fine grades for reading and mathematics. These rules also take into account situations where a pupil's assigned level for their reading or mathematics test is not consistent with the mark they receive.

- If test level = 6 then:
 - **Fine Grade** = 6.5
- If test level = 3, 4 or 5 then:
 - If main test mark exists and is consistent with level, then:

$$\text{Fine Grade} = \frac{\text{mark} - \text{level min}}{\text{level max} - \text{level min} + 1} + \text{level}$$

- If main test mark exists and is **not** consistent with level:
 - If the level is higher than the mark then:
Fine Grade = Test level (3.0, 4.0 or 5.0).
 - If the level is lower than the mark then the fine grade is obtained from the maximum mark in that level, then:
$$\text{Fine Grade} = \frac{\text{level max} - \text{level min}}{\text{level max} - \text{level min} + 1} + \text{level}$$
- If test level = 2 and TA is 3+ then:
 - If main test mark exists and is consistent with level, then the difference in fine grade of one mark is extended from level 3 range.
$$\text{Fine Grade} = 3.0 - \left\{ \frac{\text{min lev 3 mark} - \text{mark}}{\text{max lev 3 mark} - \text{min lev 3 mark} + 1} \right\}$$
 - If main test mark does not exist, then we assign the pupil the middle mark of the compensatory level 2 range. If the main test mark is lower than the minimum mark for the compensatory level 2 range then we assign the minimum mark of the compensatory level 2 range and if the main test mark is higher than the minimum mark for the compensatory level 2 range then we assign the maximum of the compensatory level 2 range. Then apply the above algorithm.

Writing

As we only have teacher assessment data for writing, the fine grades outcomes are:

Writing teacher assessment level	Fine grade
W	0.5
1	1.5
2	2.5
3	3.5
4	4.5
5	5.5
6	6.5

For reading, writing and mathematics, the point score is calculated as 6 * fine grade.

Overall

The KS2 average point score (APS) for the overall VA measure in 2015 is calculated using the following formula,

$$\text{KS2 APS} = ((\text{KS2 reading fine point} + \text{KS2 writing fine point})/2 + \text{KS2 maths fine point})/2$$

For example a pupil who receives 25.68, 21.00 and 31.50 points for reading, writing and mathematics respectively would have an APS score of 27.42.

$$\text{KS2 APS} = \frac{(25.68 + 21.00)/2 + 31.50}{2} = 27.42$$

Section I – KS1-2 VA model coefficients for 2015

The table below summarises the VA model coefficients, the variance terms and standard deviations used to calculate the four KS1-2 VA scores and confidence intervals for 2015 amended data. These values are used to calculate a pupil's estimated KS2 outcome and the confidence intervals around the pupil's VA score.

Coefficient	Applied to	KS1-2 overall VA measure	KS1-2 reading VA measure	KS1-2 writing VA measure	KS1-2 mathematics VA
<i>C</i>	Constant	13.8124	13.6393	12.9758	14.3221
<i>C1</i>	<i>KS2APS</i>	0.9682	1.0398	1.3214	0.7558
<i>C2</i>	<i>KS2APS2</i>	0.000751	0.007107	-0.029938	0.012886
<i>C3</i>	<i>KS2APS3</i>	-0.000019	-0.000636	0.000688	-0.000064
<i>C4</i>	<i>READEV</i>	-0.0214	0.1614	-0.1471	-0.0488
<i>C5</i>	<i>MATDEV</i>	0.3565	0.0858	-0.2286	0.7840
<i>B</i>	Between school variance	1.252871	1.029994	1.326418	1.942651
<i>W</i>	Within school variance	5.531229	7.747603	8.218869	9.956403
σ_N	National standard deviation	2.603590	2.958793	3.085500	3.447036



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